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ESTABLISHING OPERATIONS AND REINFORCEMENT EFFECTS

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Positive reinforcement procedures have had a major impact on educational programs for the developmentally disabled; nevertheless, variation in reinforcer effectiveness both within and across individuals is a common phenomenon. This study examined one class of variables—establishing operations—that might influence the effectiveness of reinforcers. Five developmentally disabled adult males participated. Responding on one of two motor tasks—switch closure or block placement—was assessed during baseline, satiation, and deprivation conditions with respect to three classes of consequences: small food items, music, and social praise. Deprivation and satiation conditions were constructed so as not to alter significantly the normal course of events in a subject's day. For example, food deprivation entailed scheduling sessions just prior to a subject's regular lunch, and social deprivation involved limiting a subject's access to social interaction for 15 minutes, during which time the subject had access to an assortment of other activities. Results showed that each stimulus class functioned as reinforcement with different degrees of effectiveness during satiation versus deprivation conditions. These results are discussed in light of previous research on enhancement of reinforcer efficacy as well as the assessment and identification of functional reinforcers, and implications are presented for future research and client habilitation.

DESCRIPTORS: establishing operations, positive reinforcement, deprivation, satiation

Reinforcement is the most important and most basic motivational tool in teaching the mentally retarded. One of the first studies of operant reinforcement procedures with this population was reported by Fuller (1949), who reinforced arm movements in a profoundly retarded teenage boy by contingently squirting a warm sugar–milk solution via syringe into the boy's mouth. Previously, the boy's physicians had considered him "vegetative" and unable to learn. The response Fuller selected for analysis was arbitrary and insignificant as a final target behavior, but the demonstration that reinforcement principles were applicable to the behavior of even the most profoundly retarded individuals was highly significant.

In more recent studies, positive reinforcement has facilitated the acquisition of a wide range of adaptive and socially relevant behaviors for developmentally disabled individuals, including self-help (e.g., Arzin & Foxx, 1971), communication (e.g., Reid & Hurlbut, 1977), social (e.g., Whitman, Mercurio, & Caponigri, 1970), vocational (e.g., Cuvo, Leaf, & Borakove, 1978), and community survival skills (e.g., Page, Iwata, & Neef, 1976), among others. Typically, food, liquids, or social praise is used as the reinforcer with developmentally disabled populations, although there has been extensive interest in identifying sensory reinforcers such as vibration, tickling, hand clapping, light, and music (e.g., Bailey & Meyerson, 1969; Ferrari & Harris, 1981; Rincover & Newsom, 1985).

Because reinforcement effects with a given stimulus often vary across individuals, several researchers have developed methods for identifying potential reinforcers on an individual basis (e.g., Datillo, 1986; Mason, McGee, Farmer-Dougan, & Risley, 1989; Pace, Ivancic, Edwards, Iwata, & Page, 1985). One consistent finding of these studies is that reinforcement effects are idiosyncratic; it is assumed that this variability across (and even within) individuals is due in part to remote histories of reinforcement and perhaps genetics. But apart from

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individual differences resulting from these factors, it is likely that other variables also determine the momentary effectiveness of a stimulus functioning as reinforcement.

One of the clearest examples of variables that influence the momentary effectiveness of reinforcers is the continuum from deprivation to satiation with respect to a given stimulus, which is considered to be an important methodological detail in nonhuman behavioral research. For example, the *Journal of the Experimental Analysis of Behavior* routinely publishes studies in which reports of deprivation level are stated in the method sections. These motivational variables, such as food and water deprivation, have been termed *establishing operations* by Michael (1982). Michael suggested that events such as salt ingestion, temperature changes away from the organism's normal thermal condition, and food deprivation not only evoke behavior that has in the past been followed by a specific object or event but also "alter the effectiveness of some object or event as reinforcement" (Michael, 1982, p. 150). That is, such conditions establish the reinforcing value of various stimuli.

Although Michael's account of these motivational variables has important implications for human behavior, little research on establishing operations has been published in the applied literature. For example, establishing operations may have special relevance to the growing literature on reinforcer assessment for developmentally disabled people, but a close examination of those studies finds little mention of antecedent operations. This finding is surprising because the effectiveness of reinforcing stimuli might in fact be influenced by some temporary states of deprivation and satiation, which may inject variability into resulting data or may even hinder the progress of particular clients.

An early example of the effects of establishing operations on human behavior was described by Gewirtz and Baer (1958b), who recorded children's responding on a marble-dropping task both with and without a presession period of social deprivation (a condition with no communication between subject and experimenter). During sessions, social praise was used as a consequence for responding, and response rates were higher after the deprivation period. The experimenters concluded that the deprivation period increased the reinforcing efficacy of social praise. In a follow-up study, Gewirtz and Baer (1958a) demonstrated that a brief period of presession exposure to social interaction reduced the efficacy of praise as a reinforcer, apparently due to a satiation effect.

Another interesting demonstration of control by establishing operations in the applied literature was reported by Corte, Wolf, and Locke (1971), who examined differential reinforcement as a treatment for self-injury in profoundly retarded adolescents. When the adolescents were relatively food deprived (i.e., their lunch was slightly delayed), food was a more effective reinforcer in a differential reinforcement of other behavior (DRO) contingency for self-injury than when the subjects' lunch was served on time. This particular example is one of the few systematic analyses of local deprivation using human subjects and primary reinforcers. Such an experiment implicitly invokes ethical questions that perhaps underlie the absence of applied research on establishing operations: Is it appropriate or even feasible to "deprive" humans of primary or secondary reinforcers that are normally made available to them (e.g., lunch time)? Perhaps more subtly, what exactly constitutes a deprivation operation?

Other recent studies have indirectly examined variables relevant to establishing operations. For example, Egel (1980, 1981) demonstrated that varied reinforcers were more effective than constant reinforcers in maintaining correct responses during discrete-trial training with developmentally disabled individuals. It is possible to interpret Egel's findings as reduced satiation during the varied condition, such that the effectiveness of the reinforcer lasted longer within each session.

The current investigation examined some variables that may establish a stimulus as a reinforcer in one context and, conversely, abolish the reinforcing qualities of that same stimulus in another context. This type of investigation may provide suggestions for controlling variables before bringing an individual into a reinforcer assessment, training, or research session, and may also suggest ways to maximize the reinforcing capabilities of a given stimulus. The selection of stimuli for assessment in

this study was based on reinforcers commonly used in clinical and applied settings, and also accounted for primary reinforcement (food), conditioned reinforcement (social), and sensory reinforcement (music). Finally, the establishing operations in the current study did not significantly interfere with the subjects' ongoing daily routine. This feature further differentiates this study from operations employed in the basic literature (in which naturally occurring feeding and/or drinking cycles are necessarily disrupted) and suggests meaningful strategies for avoiding such ethical concerns as those mentioned above.

METHOD

Subjects and Setting

Five adult males, diagnosed as profoundly retarded, participated. All of the men resided at a state facility for the developmentally disabled.

Sam was 27 years old and was nonambulatory but could independently use a wheelchair. He followed simple instructions and could say a few words and short sentences. He was reported to have a low attention span and displayed difficulty in the use of his arms and fingers to perform fine-motor tasks such as picking up small items.

Lonny was a 28-year-old ambulatory individual who responded to simple verbal requests; however, he displayed no functional or conventional vocal behavior. Staff described his behavior as "distractible," and he also had difficulties with fine-motor tasks, although his difficulties seemed related to poor vision. Apart from the vision problem, Lonny appeared to be physically well coordinated.

Craig was a 29-year-old man who sometimes used a wheelchair but also would hop from place to place with his one fully developed leg. Craig had an extremely limited receptive and expressive verbal repertoire. He displayed good motor skills with his one fully developed arm but demonstrated difficulty in staying on task in training sessions observed prior to this study.

Donny was a 25-year-old ambulatory man who had adequate use of his hands, arms, and fingers but displayed a propensity for running away from training sessions and was reported to have a minimal number of known reinforcers suitable for his training programs. Donny sporadically followed simple verbal instructions but did not display any speech.

Similarly, 36-year-old Rich was reasonably well coordinated with his legs, arms, and fingers but often wandered away from training sessions after short periods of time. Rich complied to a number of routine verbal requests (e.g., "Get your jacket," "Take off your shoes"), but displayed no conventional language.

Sessions were conducted, usually 5 days per week, in a therapy room in an unoccupied cottage or in a room situated away from ongoing activity in the subjects' home cottage. In both rooms, the experimenter and/or an observer sat or stood several feet from the subject (depending on the experimental condition). For each subject, the location of the session was always the same for each stimulus assessment.

Selection of Stimuli

The three stimulus classes selected for analysis (small food items, music, and social praise) were chosen because they are commonly used as reinforcers in applied settings (e.g., Ferrari & Harris, 1981; Rincover & Newsom, 1985) and because they represent three discernible classes—primary, conditioned, and sensory. The stimuli were matched to subjects based on either a procedure similar to that employed by Pace et al. (1985) involving approach to the items or on information obtained via staff interviews. Thus, for each subject, there was prior information indicating that the stimulus to be assessed might function as a reinforcer in some context. Craig, Sam, and Lonny participated in the food assessment; Rich and Donny participated in the music assessment; and Donny and Sam participated in the social interaction assessment.

Procedure

Food items. The subject was guided to and seated at the table in the experimental room. A container holding approximately 250 small blocks was placed on the table in front of the subject; next to it was placed a receptacle (1 ft high) with a hole

at the top large enough for one block at a time to fit through. Each session began with a simple prompt that was not repeated at any time during the session. The experimenter said, "Do this [subject's name]," and demonstrated the response of putting one block through the hole. The experimenter then sat across the desk from the subject and watched the top of the receptacle only. If an additional observer was present, he or she sat approximately 3 m away from the subject at an angle allowing clear view of the target behavior. Sessions lasted 10 min, although the subject could stop responding at any time and was never instructed to return to the desk if he left it. The dependent variable of interest was the number of responses per minute.

During baseline conditions, sessions took place within 30 min before the subject's scheduled lunch time, and responding was met with no programmed consequence. During deprivation conditions, sessions also took place within 30 min before lunch time and commenced with the modeled response and instruction. However, responses were now followed by fixed-ratio (FR) schedules of food presentation (raisins, nuts, or dried fruit, none of which were available during the morning snack). For Craig and Sam, the schedule was FR 3, whereas Lonny's schedule was FR 5 (although the first response of each session was followed by access to food for each of the 3 subjects; this was seen as the most efficient way to allow the behavior to contact the consequence in effect). A food item was delivered by placing it on a particular corner of the desk within 1 s after completion of the schedule requirement. Along with sessions taking place prior to lunch time, it was ensured that the subject did not have access to the target food item during that morning's snack (the items were not included in the cottage reinforcer or snack supply).

During satiation conditions, sessions started within 15 min after the subject had eaten lunch. Also, the sessions were preceded by 10 min of free access to the food item. Specifically, the experimenter placed the small food item on the desk (in the designated spot); when and if the subject placed the food item in his mouth, another piece was delivered. If the subject did not consume a piece of food during any 2-min span, the 10-min free access period was terminated and the session began. The satiation condition was identical to the deprivation condition from that point on.

Music. The same general seating and prompting procedures were followed for this stimulus class; however, an automated apparatus was incorporated for the purpose of recording responses and delivering music. The target response involved pressing a small pedal (with the hand) that closed a microswitch. The only person in the room, other than the subject, was the experimenter or an assistant who sat across the table "reading" (and watching a clock).

During baseline, responding was met with no programmed consequences (other than a slight click noise by the switch closure). In the deprivation condition, an observer ensured that the subject did not have access to any musical stimulation for at least 30 min prior to the session. During sessions, responding produced music (via cassette tape) on an FR 6 schedule; the duration of music was 4 s for Rich and 4 s and later 12 s for Donny. As with the food assessment, the first response of each session was followed by the relevant consequence.

During the satiation condition, an experimenter played taped music (the same or similar tape to be used in the session) in a room where the subject happened to be sitting or standing for 30 min prior to the session. The music was played at a level deemed audible throughout the room, but an attempt was made to keep the music's source within 2 m of the subject. Sessions began at the end of the 30 min of music and, from this point on, were the same as those described in the deprivation condition.

Social interaction. The block-placement task was used as the target response for this stimulus class, and the same general seating and prompting procedures described above were followed. As with the other stimulus assessments, the baseline condition provided no programmed consequence for responding. The other conditions differed somewhat for the 2 subjects (Donny and Sam).

In the deprivation condition, an observer watched Donny until a period of 15 min had passed in

which there was no social interaction between the subject and any other person. During this 15-min span, the subject was not socially isolated; games, water, and other materials were available, but the observer explicitly did not interact with the individual. This condition was conducted in Donny's home cottage. Staff members were asked to "allow Donny to play or work by himself for a while," and they were assured that he would be monitored. Following the 15-min period, the session began. Responses on the block task were followed by social praise on an FR 10 schedule (after the initial FR 1 as described in the previous conditions). Social praise consisted of an experimenter approaching from a distance of about 2 m to a distance of about 1 m and stating any one of six praise statements such as "Good job Donny! You are a hard worker," or "Wow, I sure like it when you work this hard." The praise statements were presented in a quasi-randomized order.

During satiation conditions, the experimenter met with Donny for 15 min prior to the session and provided continuous interaction (e.g., simple game playing and conversation) and noncontingent statements of verbal praise at least once every 15 s (mixed in with the normal conversation). Sessions then followed the same format as that described for deprivation conditions.

Informal observation of Sam showed that he spent much time asking for acknowledgment of the "field trip passes" he carried around (which were actually torn strips of paper on which staff frequently wrote various words). He did this by persistently holding out the paper towards staff members and saying "field trip." Thus, the social consequence assessed for Sam was more idiosyncratic than for Donny, because the "passes" were used as the occasion for social reinforcement.

Baseline conditions, using the block task, matched those presented to subjects in the food-item assessment. Because he had been a subject in that component of the study, Sam had previous experience with the block task several months earlier.

During deprivation conditions, Sam was placed in a room alone for 15 min with various play materials and two blank torn sheets of paper similar in size to the ones he often carried around, although he did not have access to any marked "field trip pass." At the end of the 15-min period, during which Sam spent most of the time looking at coloring books, sessions began. The experimenter provided contingent interaction on an FR 3 schedule by acknowledging Sam's field trip pass, saying "I'd better write _____ on your pass" and writing one of seven predetermined words or phrases such as Sam's name, the experimenter's initials, or the name of the research site in a quasi-randomized order.

During the satiation period, the experimenter acknowledged Sam's "passes" for 15 min prior to the session, continuously writing and saying one of the seven words or phrases. Following the 15-min satiation period, sessions matched those described in the deprivation phase.

Recording and Reliability

Observers recorded the subjects' performance on the block task on a hand-held counter. Each block placed in the receptacle was counted as one response. Counting blocks in the receptacle at the end of the session proved to be an inexact measure because several of the subjects would occasionally overturn the receptacle and shake out several blocks. Therefore, responses were counted as they occurred. For each subject and for each condition of each assessment, a reliability observer simultaneously collected data during 20% or more of the sessions. Agreement was calculated by dividing the smaller number of responses counted by the larger number of responses counted and converting into a percentage. Overall agreement scores exceeded 97% in all conditions for all subjects. When possible, the rare discrepancies were rectified by counting the blocks in the receptacle following the session.

Procedural Integrity

During assessments involving food, the procedure was kept consistent by always placing the food item in the same general spot on the desk, by placing it within 1 s of the completion of a ratio requirement, and by requiring the experimenter to avoid eye contact with the subject. Observers re-

Table 1
Overall Mean Response Rates: All Stimuli

Stimulus	Baseline	Satiation	Deprivation
Food			
Craig	0.36	0.68	2.62
Sam	0.93	2.80	4.64
Lonny	2.65	0.42	9.48
Music			
Rich	2.16	1.54	8.24
Donny	5.88	2.48	5.06
Social			
Donny	2.48	10.36	17.78
Sam	1.34	3.99	5.32

ported no procedural variation from these dimensions.

During assessments involving social consequences, procedural reliability was established by preselecting the consequences to be delivered, keeping experimenters constant, and having interactions timed in at least 20% of the sessions in each condition (in Sam's case). Interactions with Sam lasted an average of 5.4 s in satiation conditions and 5.5 s in deprivation conditions. No other procedural variations were reported.

When the electronic apparatus was used during the music conditions, responses were recorded automatically and totals were written down at the end of the session by the experimenter. Prior to each session, the accuracy of the machine was calibrated in terms of response recording and duration of stimulus presentation. The apparatus remained accurate throughout the study.

RESULTS

Overall Results

Table 1 shows the mean response rates for all subjects across baseline, satiation, and deprivation conditions. There were large differences in absolute response rates across subjects; for example, whereas Donny responded an average of 17.8 times per minute in the social deprivation condition, Craig responded only 2.6 times per minute in the food deprivation condition—even though both assessments involved the block task. Despite individual differences, each subject showed higher rates of responding in deprivation than in satiation; particularly large differences between conditions can be seen in Lonny's food assessment (9.48 vs. 0.42) and Rich's music assessment (8.42 vs. 1.54). Relatively small differences are seen in Sam's social interaction (5.32 vs. 3.99) and food assessments (4.64 vs. 2.80). In every case, mean response rates during deprivation were higher than in baseline, except in Donny's music assessment (the reasons for this are discussed below).

Food

The upper panel of Figure 1 shows Craig's session-by-session response rates on the block task. His responding decreased throughout baseline, eventually approaching zero (condition $M = 0.36$ responses per minute). During the first deprivation condition, when contingent food was first presented, Craig's responding increased immediately ($M = 2.54$ responses per minute). His response rate subsequently decreased and again increased as a function of satiation followed by deprivation ($M = 0.68$ and 2.67 responses per minute, respectively). These results indicate that food functioned as a more effective reinforcer during the deprivation condition.

The middle panel of Figure 1 shows Sam's data. His responding also decreased markedly during baseline; occasionally he exhibited no responses during an entire session ($M = 0.93$ responses per minute). During the first satiation condition, his response rate increased noticeably ($M = 2.16$ responses per minute) and increased even further during the subsequent deprivation condition ($M = 4.38$ responses per minute). Responding decreased slightly during the second satiation condition ($M = 4.18$ responses per minute) and increased again during the final deprivation condition ($M = 5.17$ responses per minute). An overall acquisition effect is evident following baseline, but is especially clear after Sam broke his arm in an accident unrelated to the experiment (arrows in Figure 1). Thus, the results indicate that although food functioned as reinforcement during both satiation and depriva-

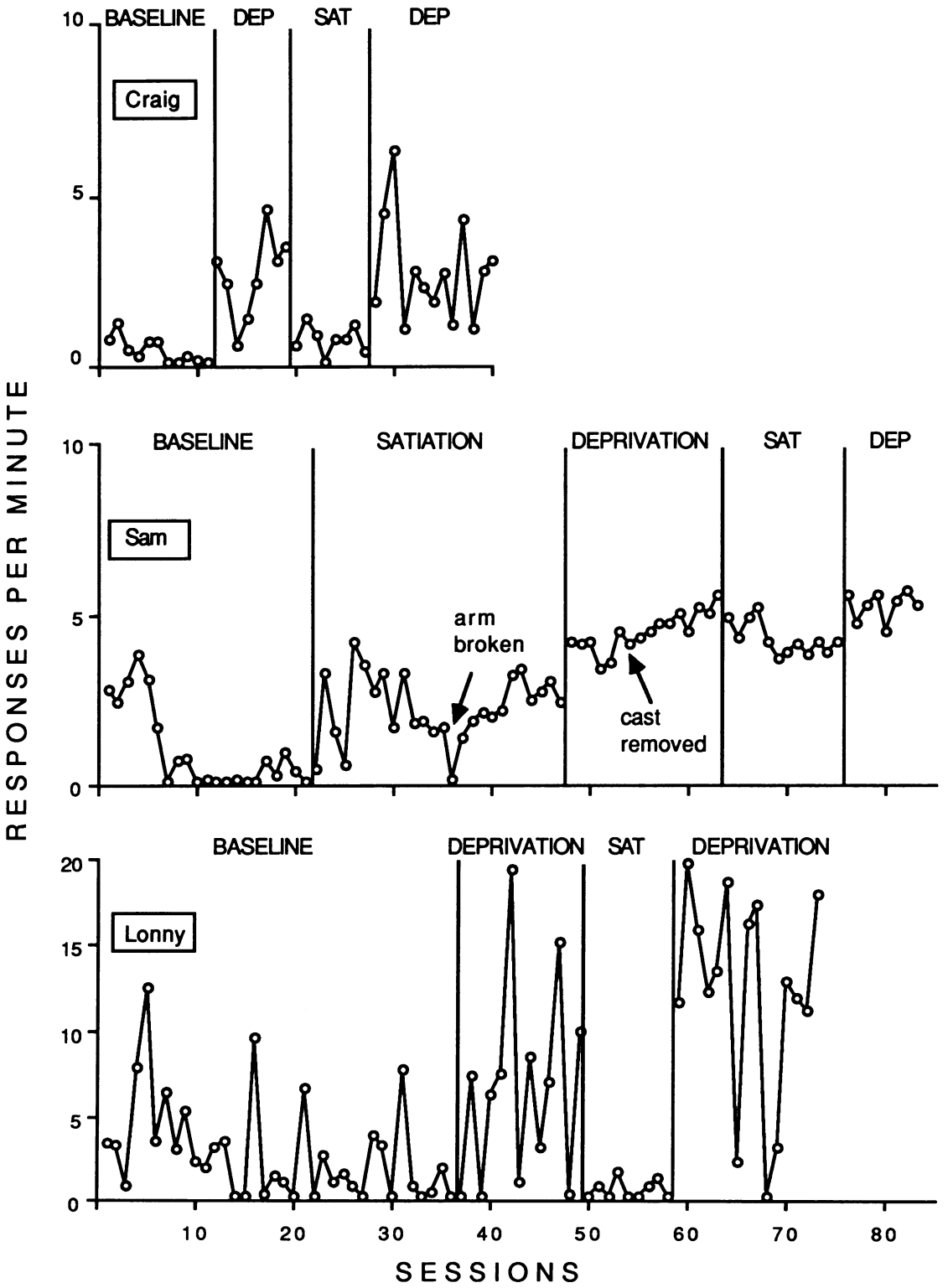

Figure 1. Responses per minute in food assessment for Craig, Sam, and Lonny during no reinforcement (baseline) and reinforcement (deprivation, satiation) conditions.

tion, deprivation enhanced the overall acquisition effect.

The lower panel of Figure 1 displays Lonny's data. During baseline, responding was variable and showed a decreasing trend (M = 2.65 responses per minute). During deprivation, responding remained variable (ranging from 0 to 19.9) but increased markedly (M = 6.44 responses per minute). In satiation, his response rate again decreased and approached zero (M = 0.42 responses per minute). Finally, responding in the second deprivation condition increased substantially (M = 12.1 responses per minute). These data indicate that food functioned as reinforcement during the deprivation conditions and that the presession satiation almost entirely eliminated the reinforcing efficacy of food.

It is noteworthy that Sam consumed food items throughout the presession exposure period before every satiation session, whereas Lonny did for most of the sessions, and Craig generally stopped eating them after about 1 to 2 min of exposure. Thus, it is unclear whether the relevant satiation effect took place during the presession exposure, during lunch, or as a function of some combination of the two events.

Music

The upper panel of Figure 2 displays Rich's session-by-session response rates on the switch-closure task. A relatively low and descending rate of response was observed in baseline (M = 2.16 responses per minute), followed by a marked increase in the first deprivation condition, during which music was first presented (M = 10.2 responses per minute). Responding then decreased to approximately baseline levels during the first satiation condition (M = 2.41 responses per minute), followed by an increase during the second deprivation condition (M = 5.06 responses per minute). In the second satiation condition, the rate again decreased (M = 0.81 responses per minute). Thus, music showed a differential reinforcement effect in deprivation versus satiation conditions, but the data also suggest an overall across-sessions satiation (or habituation) effect because the entire curve of the graph is descending, although it is temporarily interrupted by deprivation. The across-sessions effect replicates the findings of Rincover, Newsom, Lovaas, and Koegel (1977), who showed that the reinforcing effect of taped music decreased after a series of sessions.

After Rich's two deprivation and satiation conditions, a varied reinforcement condition (Egel, 1980, 1981) was implemented in an attempt to increase responding. During this condition, praise, a new tape of music, or food was delivered in random order after completion of the FR 6 requirement. Following an initial increase in responding, another across-session decrease in responding was observed (M = 4.42 responses per minute). Because of these mixed findings, it is more difficult to determine precisely the effects of the presession manipulations on Rich's behavior.

The lower panel of Figure 2 displays Donny's data. In baseline, initially high rates of responding eventually decreased and stabilized at a rate near zero (M = 5.88 responses per minute). The first four sessions of the baseline account for the condition mean that is higher than the overall means during satiation and deprivation (see Table 1). In many of the last 11 sessions of baseline, any responding that occurred happened almost immediately after the initial instruction. During the first satiation condition, the initial exposure to the music consequence produced a relatively high rate of responding, but the rate then descended and approached zero (M = 3.97 responses per minute). In the first deprivation condition, responding did not differ markedly from the first satiation condition until the duration of the music was increased from 4 to 12 s (arrow in Figure 2); prior to that manipulation, the mean rate was 3.81 responses per minute, whereas after the change it was 6.30 responses per minute. The change in stimulus duration was made after informal observation of Donny suggested that music was functioning as a reinforcer in some contexts (i.e., he was often seen dancing, smiling, and orienting to music outside of the experimental setting). Thus, it was felt that perhaps the short duration of exposure accounted

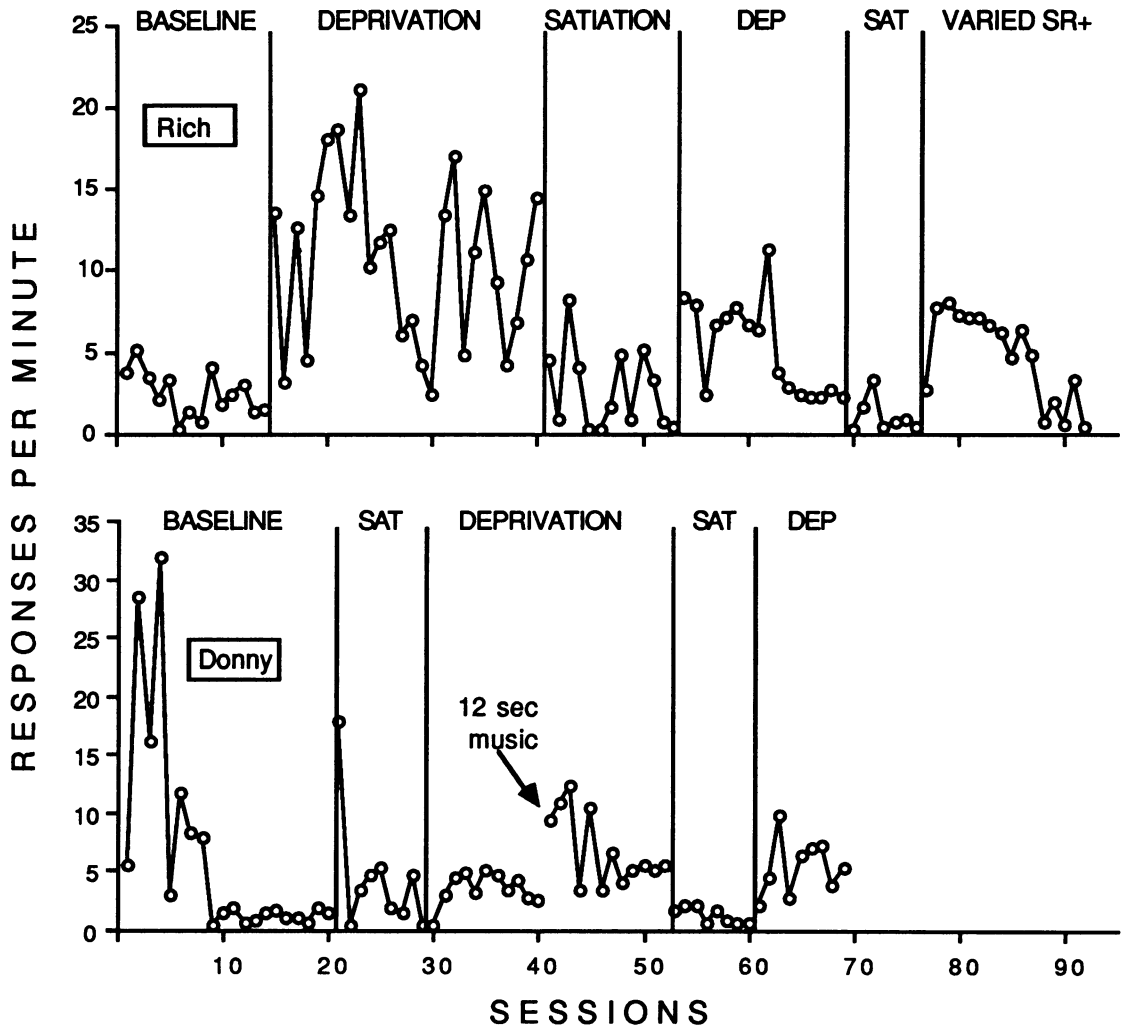

Figure 2. Responses per minute in music assessment for Rich and Donny during no reinforcement (baseline) and reinforcement (deprivation, satiation) conditions.

for the lack of a reinforcement effect, and the data indicate that this was probably the case. Subsequently, responding in the second satiation condition decreased to low rates similar to the last several data points in baseline (M = 0.8 responses per minute), even though the duration of music was still 12 s. Finally, responding increased again in the second deprivation condition (M = 4.92 responses per minute). Thus, the results for Donny indicate that the degree of presession exposure influenced the efficacy of music only when the duration of the consequence was long enough for the event to function as reinforcement in the deprivation condition.

Social Interaction

The upper panel of Figure 3 displays Donny's session-by-session response rates on the block task. His responding stabilized at a low rate during baseline (M = 2.48 responses per minute). During the first deprivation condition, responding increased and occurred at consistently high rates (M = 20.3 responses per minute). The rate during satiation was comparatively low (M = 10.4 responses per min-

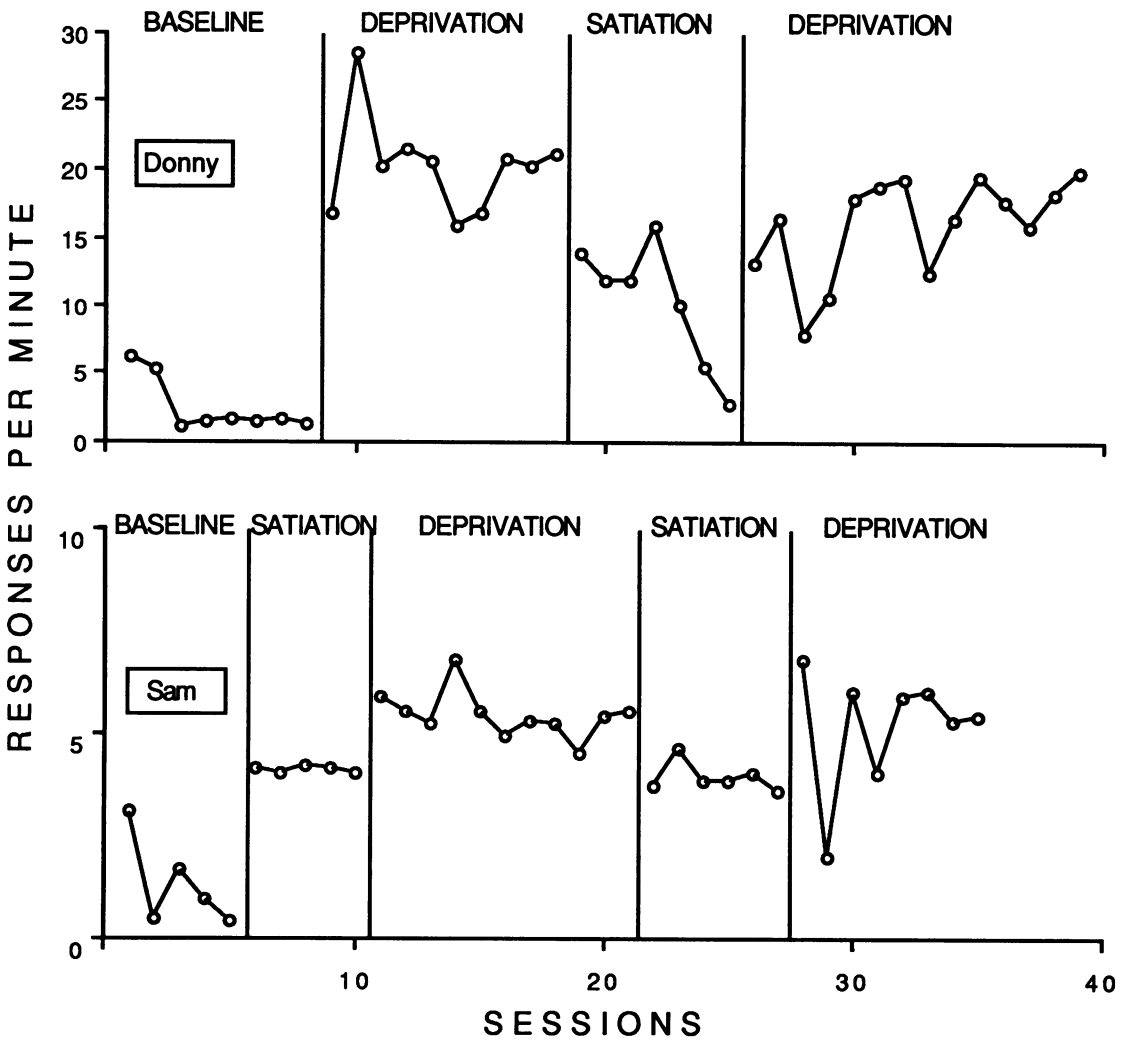

Figure 3. Responses per minute in social interaction assessment for Donny and Sam during no reinforcement (baseline) and reinforcement (deprivation, satiation) conditions.

ute) and was descending when the transition to the second deprivation condition occurred. Interestingly, after two satiation sessions, Donny began to display escape behaviors during the presession interaction, such as moving across the room or running away from the experimenter. Eventually, this apparent escape responding escalated to aggression in the form of throwing objects at the experimenter. These informal observations suggest that social praise or attention not only lost reinforcing efficacy but also may have acquired aversive properties. The brevity of the satiation condition was, in fact, due to the escalation of inappropriate and aggressive responding. The difference between responding in the first deprivation condition and the satiation condition was clear enough that a return to the deprivation condition was made to avoid inadvertently supporting inappropriate behavior. The apparent aversive nature of the social interaction was only temporary because rates of responding recovered during the second deprivation condition (M = 15.0 responses per minute). Also, no further aggression or escape responding was observed in the presession setting.

The lower panel of Figure 3 shows Sam's data. Responding decreased throughout baseline (M =

1.34 responses per minute). The rates increased relative to baseline in each of the satiation (M = 4.08 and 3.92 responses per minute) and deprivation conditions (M = 5.42 and 5.18 responses per minute). These data indicate that contingent interaction involving Sam's "pass" functioned as reinforcement for the target response in both satiation and deprivation conditions, but was more potent in the deprivation conditions.

DISCUSSION

Results of this study showed that response rates during reinforcement conditions varied as a function of relative deprivation versus satiation. These effects were shown across subjects, as well as across two tasks and three classes of reinforcers. The results thus extend Michael's (1982) analysis of establishing operations to the behavior of developmentally disabled individuals. Of particular interest was the finding that the deprivation and satiation levels used in this study were quite commonplace and generally took advantage of naturally occurring activities and events. In no case was an invasive deprivation period required to enhance the efficacy of the reinforcers. These results have implications for reinforcer assessments, future research, and habilitation of developmentally handicapped people.

Much of the variability found in assessments of reinforcer value (as discussed by Mason et al., 1989) could be, in part, a function of presession variables. The data obtained in this study support the notion that presession variables should be held constant and described during reinforcer assessments. Additionally, information about reinforcers gathered in one context may not apply to some other context. For example, it might not be wise to hold an assessment session prior to lunch one day and use the obtained results to select reinforcers for training sessions that will take place after meals on another day.

It is also possible that many "failed" attempts to apply reinforcement procedures in the literature and in general practice may not only be a result of a failure to identify functional reinforcers (via assessment) but may also be a failure to establish functional reinforcers (via manipulation of antecedent variables). For example, a therapist might find that preferred stimuli for a client include food, air from fans, and fluid. The therapist might then apply the principles of establishing operations by using specific stimuli as consequences at the time when they are likely to be most effective: food before meals, the fan at the hottest point of the day, and fluid after some specified time that the client has gone without a drink or in conjunction with salty food such as crackers. A failure to consider these variables may be translated (falsely) as a failure of positive reinforcement.

The notion of intentionally strengthening stimuli as reinforcers via establishing operations has administrative implications for scheduling daily activities as well as for scheduling access to various stimuli. It is often thought that constant stimulation is optimal for the development of disabled individuals because of their limited access to stimuli. But results of the current study suggest that performance during training sessions may be enhanced by actually scheduling "time away" from social contact and other stimulation; this replicates earlier findings with normally developing children (see Gewirtz & Baer, 1958b). Thus, it is conceivable that constant stimulation may hinder a client's progress because the value of social reinforcement is not being optimized. Alternatively, long periods of noncontingent stimulation probably require frequent switching of reinforcers, because the data obtained in this study suggest that relatively brief exposure to a given stimulus may diminish its relative value as a positive reinforcer. The case of Donny represents an extreme example of this phenomenon, in which a stimulus functioning as a positive reinforcer became an apparently aversive event within a 15-min period of exposure.

Another finding of this study is that the effects of deprivation and satiation extended to consequences generally considered to be conditioned generalized reinforcers—reinforcers not generally thought to be readily susceptible to satiation—such as social praise and attention (see Skinner, 1953, for a discussion). Similarly, although satiation effects have been explored to some extent with sen-

sory reinforcers (Rincover & Newsom, 1985; Rincover et al., 1977), a direct analysis of the relationship between establishing operations and subsequent efficacy had not been carried out previously.

In this study, the effective establishing operation was deprivation, by virtue of limiting a subject's access to a stimulus. However, there seem to be certain conditions in which these operations do not have the same effect. For example, Ayllon and Azrin (1968) demonstrated that presession exposure to a stimulus class can sometimes enhance the value of that event as reinforcement. Specifically, the subjects in their experiment were required to sample various events, such as movies and walks. This sampling procedure increased the subjects' attendance at these events, suggesting that the reinforcing efficacy of the events had been established by the exposure. Extensions of this sampling procedure have intuitive appeal. For instance, many people have experienced the increased likelihood of reaching for a potato chip or peanut after having a taste of the item. The notion of sampling is relevant to the present discussion because, at some point along a continuum of exposure, sampling becomes a satiation operation. These issues should be explored in future research. In this study, the procedural operations were described as satiation and deprivation, but they represented the processes of satiation and deprivation only insofar as there was a subsequent effect on reinforcer value.

Other issues involve session length and contiguity in time between the establishing operation and the actual session. Certainly session length was arbitrary in this study, and differing lengths would presumably result in different effects of the establishing operation. Similarly, it is likely that when satiation operations are less contiguous with actual sessions, the effects of the operation would wane, but it is unknown what sort of time frame will ultimately prove to be critical. Such variables are probably idiosyncratic across individuals.

Finally, it should be pointed out that the effects observed in this study were not always large; nevertheless, small within-session differences can have a large cumulative effect when an individual is repeatedly exposed to similar conditions, although the extent of such effects remains unexplored. Furthermore, the range of stimuli and response classes influenced (whether directly or indirectly) by establishing operations remains an issue, because this study focused on relatively simple consequences and simple classes of responses. It is likely that the effects of antecedent operations become increasingly complex as the relationship between functional stimulus classes and response classes increases in complexity (see Michael, 1982, for a thorough discussion). Thus, the extent to which consideration of establishing operations in applied settings will augment treatment procedures and enhance the knowledge of the field remains an open question.

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